

The background of the slide is a composite image of space. On the left, a large, detailed view of Earth is shown, with blue oceans, white clouds, and brown and green continents. On the right, a large, grey, rocky asteroid is depicted, covered in numerous smaller craters and having a prominent dark crater on its side. The background is a dark, star-filled space.

Defending the Earth from Asteroid Strikes

Richard Ignace

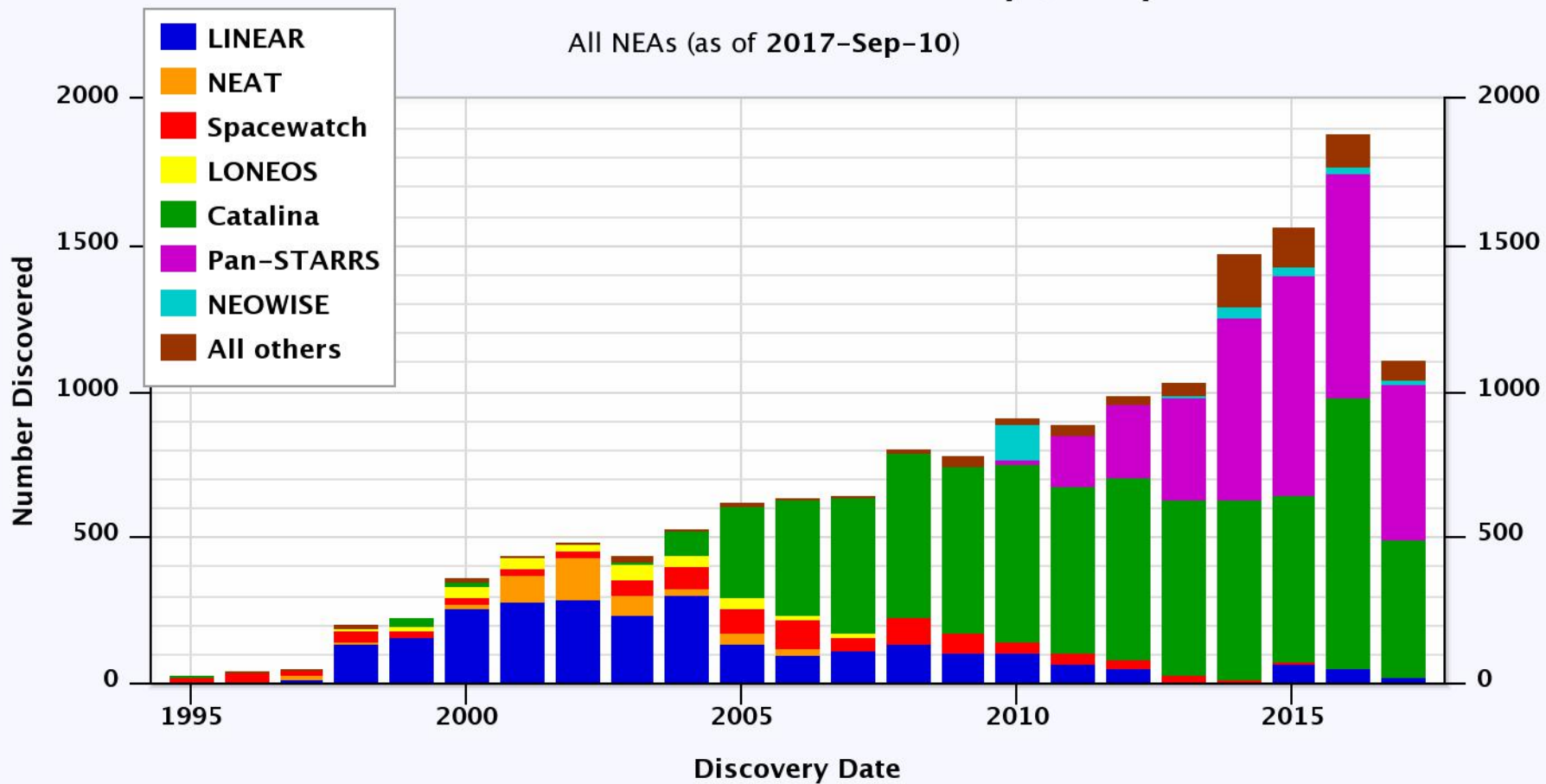
Physics & Astronomy

East Tennessee State University



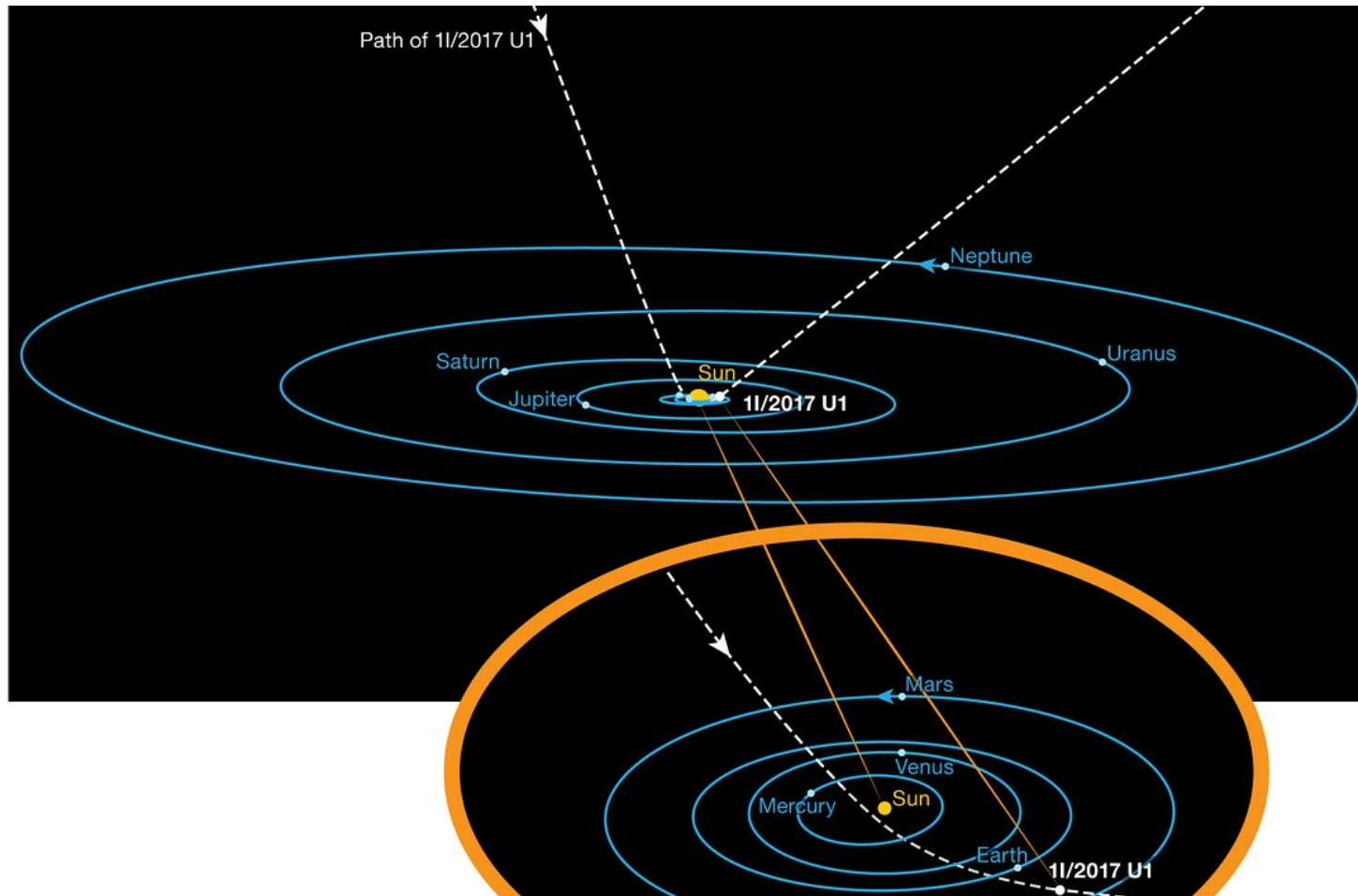
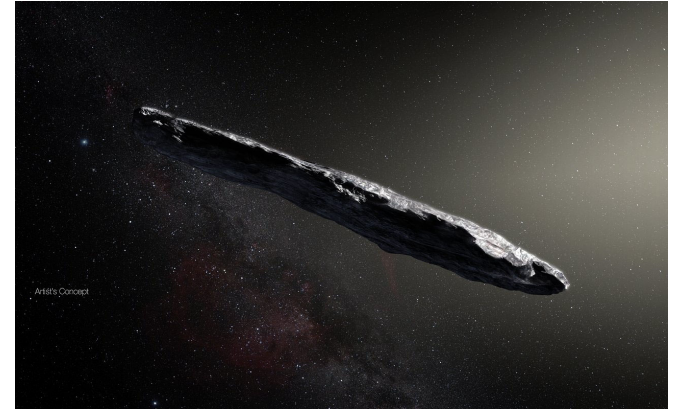
Near-Earth Asteroid Discoveries by Survey

All NEAs (as of 2017-Sep-10)

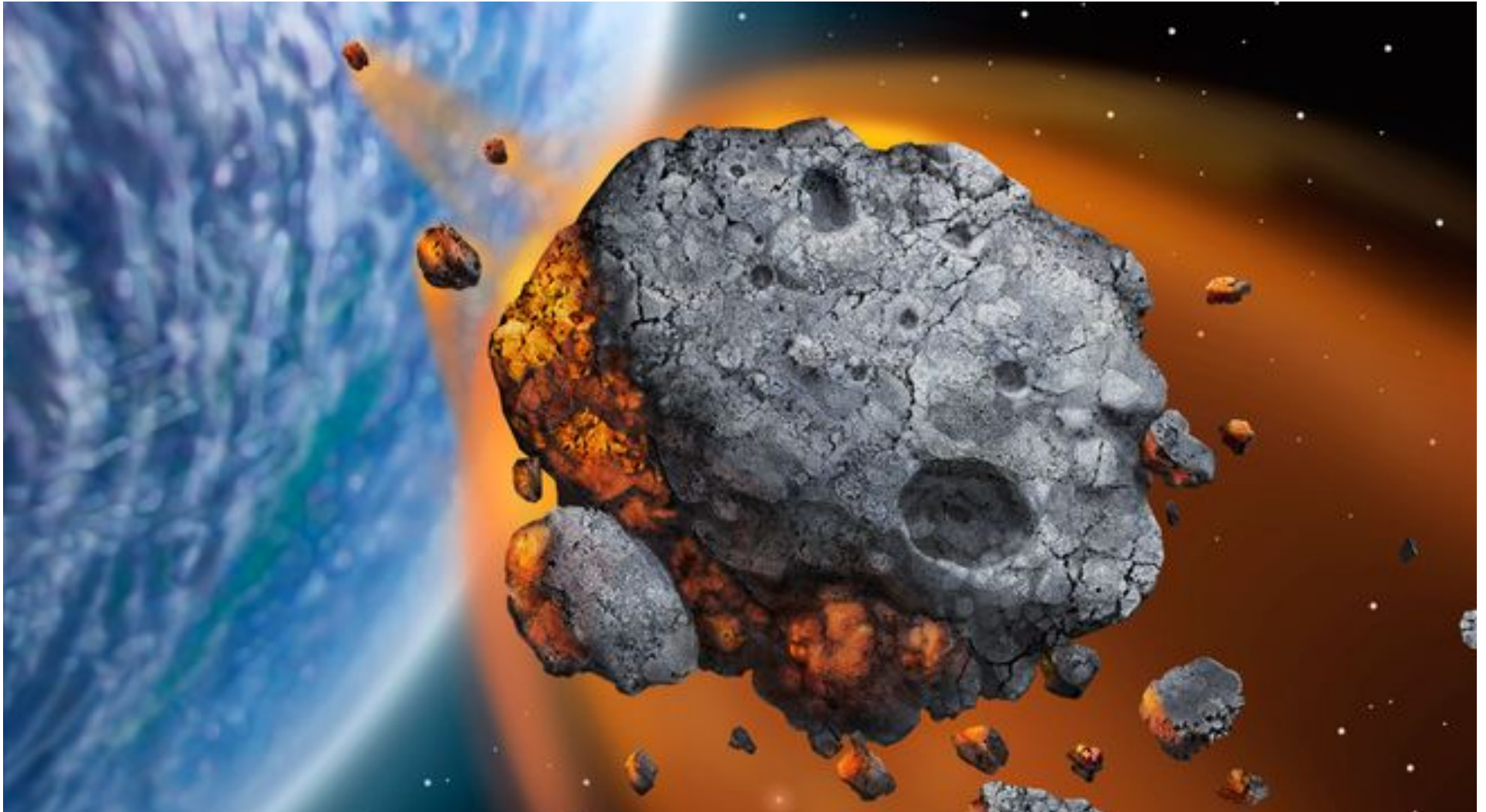


Oumuamua

interstellar interloper



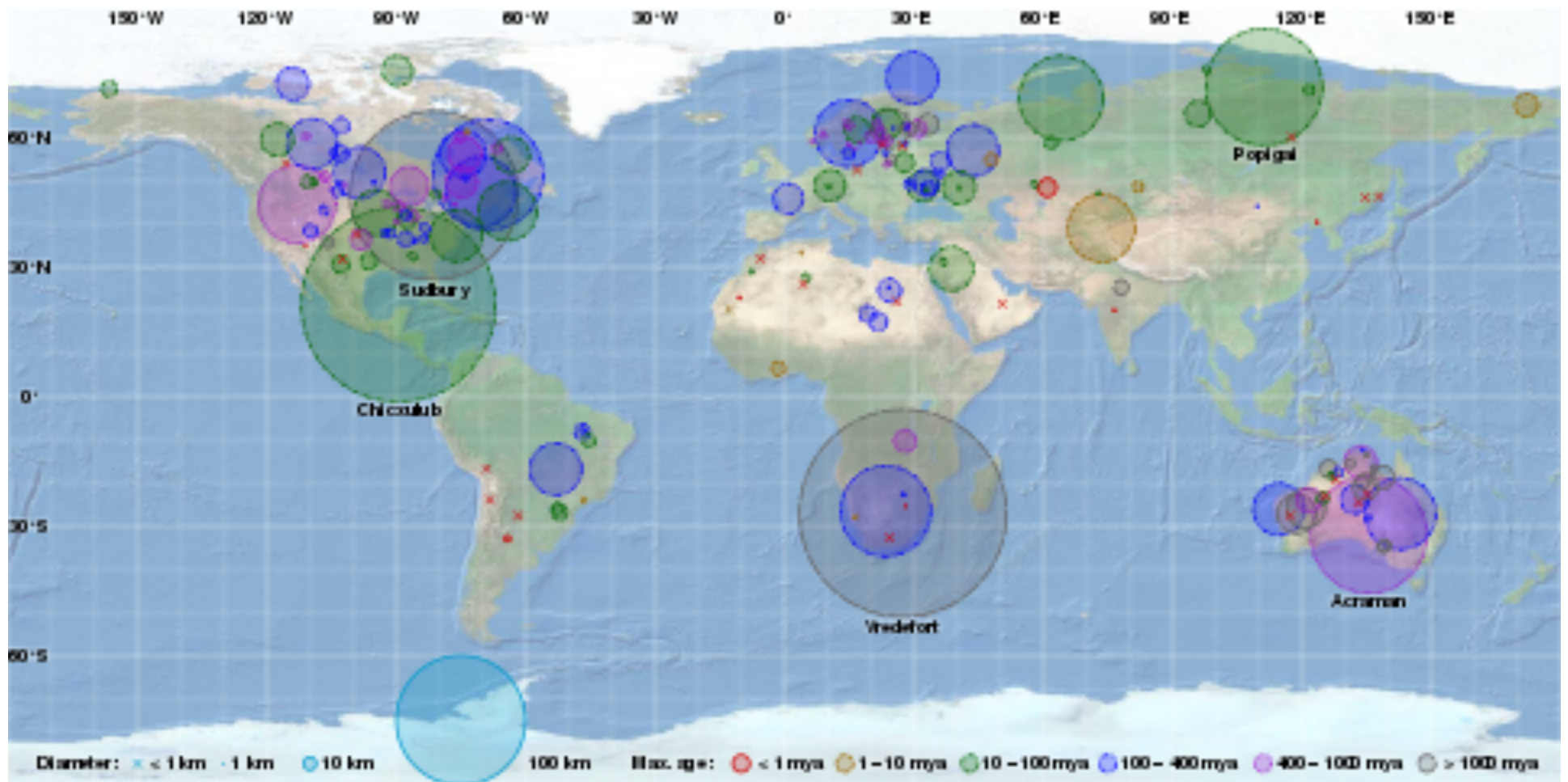
The Reality of Impacts



The Barringer Crater

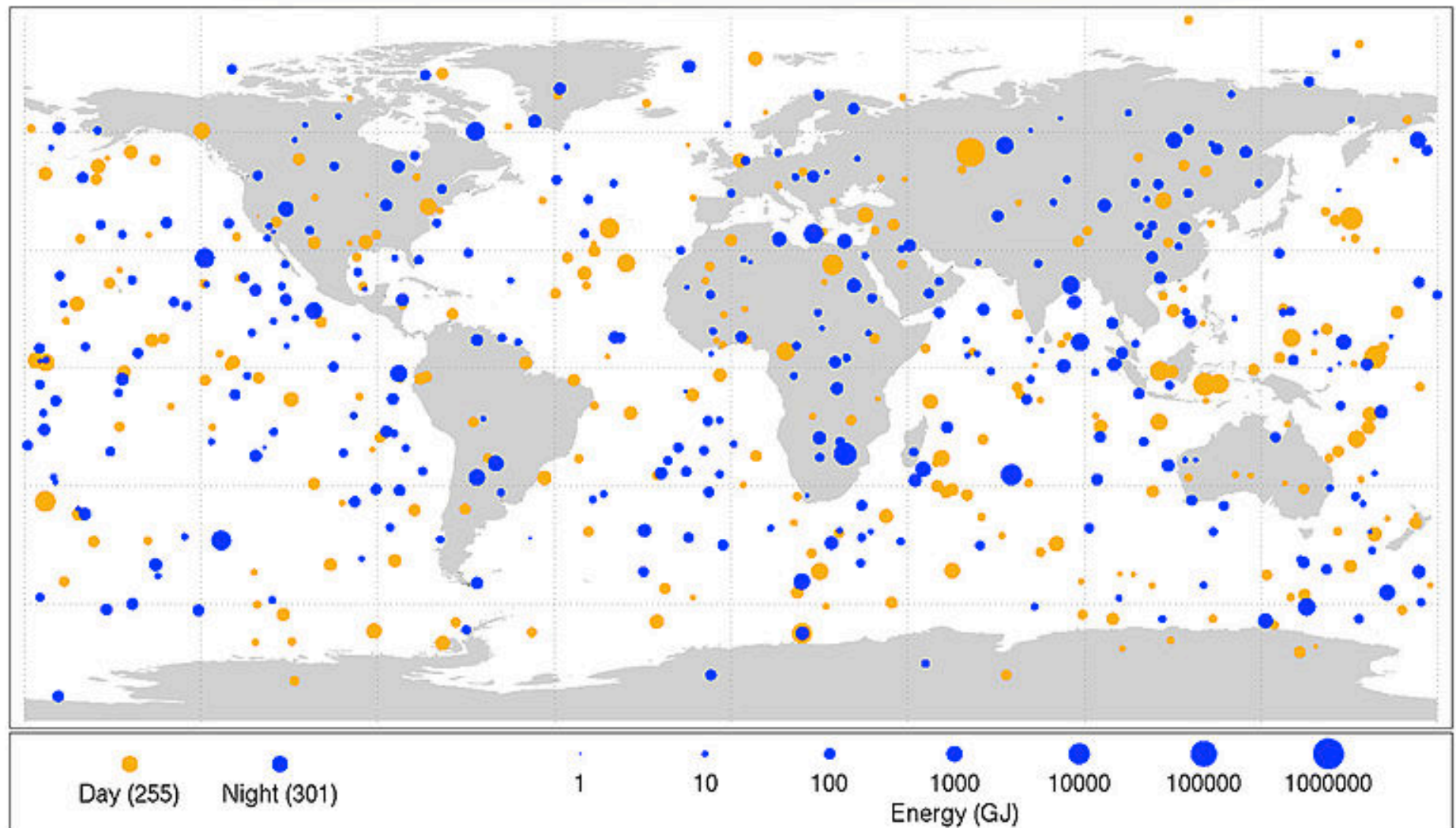


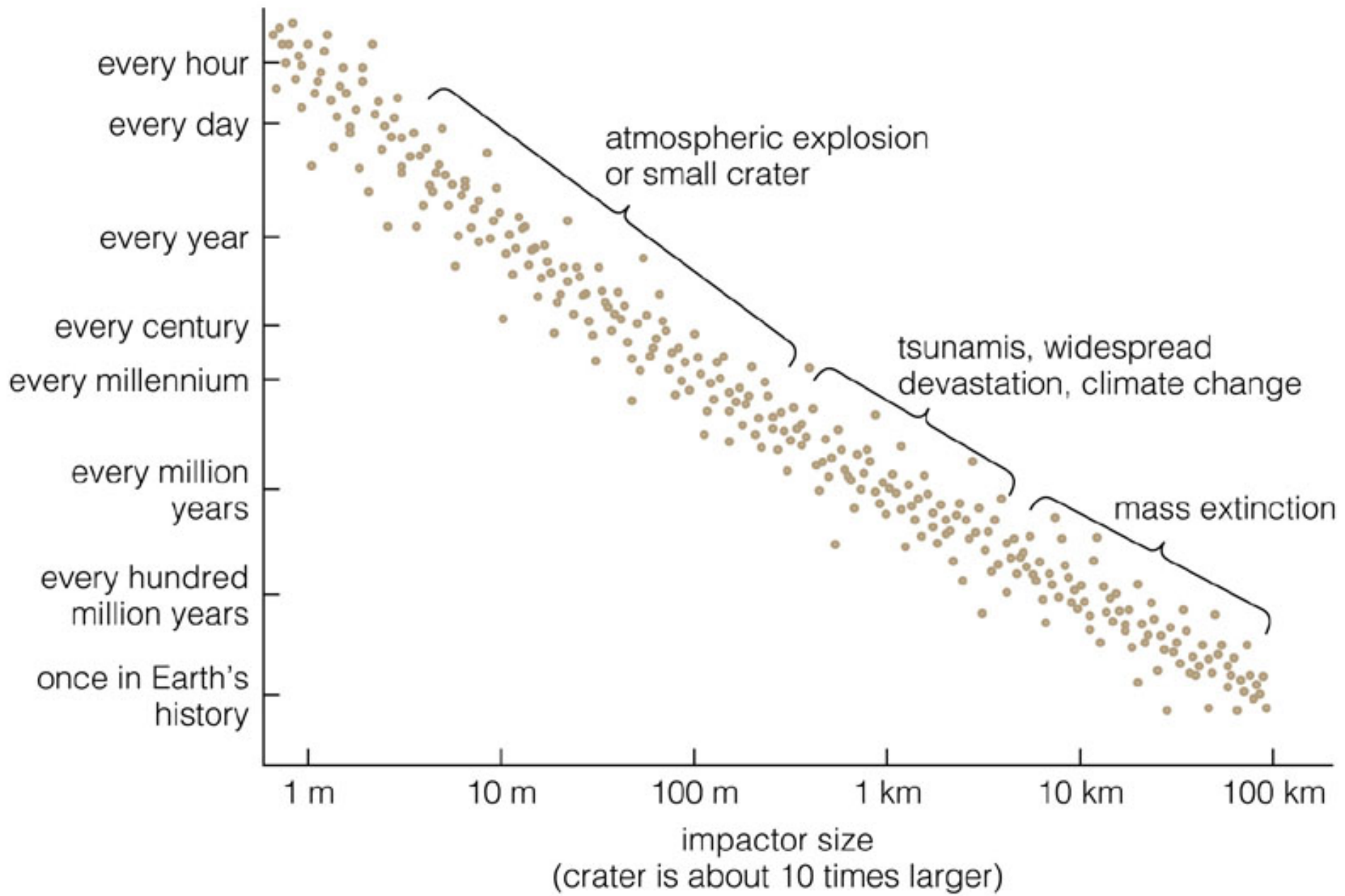
Impacts Across the Globe



Bolide events 1994-2013

(Small asteroids that disintegrated in the Earth's atmosphere)





YOUR INPUTS

Diameter: 500 m
 Density: 1260kg/m³
 Angle: 45 degrees
 Velocity: 13 km/s
 Target: Crystalline Rock
 Your Distance: 5 km



ATMOSPHERIC ENTRY



More data available

ENERGY



1.66 x 10¹³ MegaTons TNT

More data available

GLOBAL DAMAGES



Day change: not significant

More data available

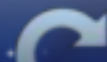
CRATER



Complex Crater

More data available

EJECTA



Arrival: 32 seconds

More data available

THERMAL RADIATION



More data available

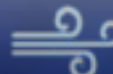
SEISMIC EFFECTS



Arrival: 1000 milliseconds

More data available

AIRBLAST



Arrival: 15.2 seconds

More data available

TSUNAMI



No data to report



CALCULATE ANOTHER IMPACT

DEFENDING EARTH

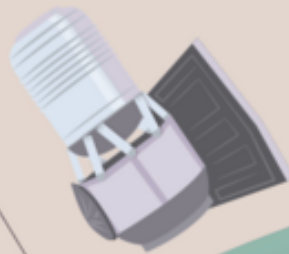
With advanced planning and preparation, we could prevent a disastrous impact from an asteroid or comet. The Planetary Society breaks it down into these five steps for saving the world.

2. Track

If we find a near-Earth object, how do we know if it will hit Earth? We need to map its orbit by taking repeated observations. A number of missions, observatories, and systems track the orbits of NEOs, and more are in development.

1. Find

Astronomers use ground- and space-based telescopes to spot NEOs and have found 90% of the largest ones. Infrared imaging also helps find objects that are too dark to see from their reflected light.




Find out more at planetary.org/defense

4. Deflect

There is a variety of possible techniques for deflecting a potential impact, but all need more development and testing:

Slow gravity tractor: A massive spacecraft follows next to the near-Earth object and uses the spacecraft's gravity to pull the object off its collision course.



²⁸Ni
Nickel

¹⁴Si
Silicon

3. Characterize

By characterizing the spin rate, composition, and physical properties of potentially hazardous NEOs, we can better know how to deflect them. Awardees of The Planetary Society's Shoemaker NEO Grant Program are making tremendous contributions in this area.

5. Coordinate and Educate

An asteroid impact is a worldwide issue that requires immense advance coordination and education. The Planetary Society is taking an active role by working with governments around the world, hosting conferences, doing public outreach, and supporting volunteer efforts.



Kinetic impactor: A swarm of spacecraft slam into the object to knock it off course.



Laser ablation: A spacecraft uses lasers to vaporize rock on the object, creating jets that push it off course. The Planetary Society is researching this technique with the University of Strathclyde through their Laser Bees project.



What about the nuclear option?

Detonating nuclear devices on or beside an asteroid may be the only viable technique we have today for deflecting an asteroid. But this comes with challenges, including political opposition and the danger of fragment impacts.

